Project Integration Architecture: One Possible Commercialization Plan

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ABSTRACT: *A plan is presented for the possible commercialization of the Project Integration Architecture (PIA) technology. The proposed scheme centers around an open-source, freeware distribution of the generic, core integration technology, perhaps under the auspices of a multi-party, multi-sector standards group. Revenue streams would derive from services perhipheral to that core including service/support, expertise/training, generic tools, provision of conformant wrappers to applications of broad appeal, and provision of served applications over the global internet.*

1 Introduction

1.1 History

In the late 1980's, the Integrated CFD and Experiments (ICE) project [1, 2] was carried out with the goal of providing a single, graphical user interface (GUI) and data management environment for a variety of CFD codes and related experimental data. The intent of the ICE project was to ease the difficulties of interacting with and intermingling these disparate information sources. The project was a success on a research basis; however, on review it was deemed inappropriate, due to various technical limitations, to advance the effort beyond the successes achieved.

A re-engineering of the project was initiated in 1996 [3]. The effort was first renamed the Portable, Redesigned Integrated CFD and Experments (PRICE) project and then, as the wide applicability of the concepts came to be appreciated, the Project Integration Architecture (PIA) project. The provision of a GUI as a project product was eliminated and attention was focused upon the application wrapping and integration architecture. During the intervening years, work has proceeded and an operational demonstration of the PIA project in a C++, single-machine implementation has been achieved.

1.2 Key Contributions

The PIA technology provides a number of benefits. Among the more significant are the following.

1. Complete engineering process capture is possible to the extent desired.
   (a) A complete derivational history of every project configuration investigated can be captured, producing an auditable trail from final design back to initial guess.
   (b) Technologist's journals, notes, and the like can be captured, allowing the record of thinking to be retrievable in the context of the hard data of the project.
2. Integration of applications into a functional whole is possible, allowing for the complex analysis of entire systems.
3. Rigourous design configuration synchronization is enforced, eliminating mis-matched analyses between integrated applications.
4. The classic *n-squared* integration problem is solved through the use of semantically-defined parameters.

5. Dimensional unit confusion is eliminated by encapsulating in parameters a self-knowledge of their own dimensionality.

6. Quality values (good, bad, and, potentially, a range in between) are captured allowing bad data or designs to be retained in the record without concern that they might be inadvertantly relied upon as being good.

7. Application integration is achieved without the necessity of re-coding those applications to the standard. The wrapping nature of the architecture decouples commitment to the integration standard from the capital assets of the wrapped applications.

8. The wrapping nature of the architecture also allows for multiple wrappers to the same application. Among other things, wrappers appropriate to the skill level of various users might be developed.

1.3 Technology Transfer

As with many research technologies, the PIA project can contribute to the greater good in two general ways: first, through a demonstration of techniques, methods, processes, and the like that can be transferred, philosophically or literally, to other areas, and second, through the direct migration of the technology as a whole from a research effort to a commercial product in its own right. Over the course of past effort, PIA has indeed contributed in the former manner. It now remains to examine if and how the developed technology might make the second form of transition to a commercial product.

2 Basic Concepts

The assertion that forms the foundation of the commercialization plan being proposed is that PIA is, at its heart, an application integration standard. PIA is something to which application wrappers based upon its technology conform. In being a standard, this then implies that more than one party desires to conform to it in order to obtain the benefits of standardization.

It is further proposed that revenues derive from the benefits delivered to the customer. It is in conformance to the standard, rather than in the standard itself, that the true benefits derive and, thus, the source of revenue is identified. Following this logic, the PIA technology, being a standard, and its implementation, is not the revenue source. Rather, it is in products that conform to and support the PIA technology standard that the primary revenue stream is to be found.

As a parallel, consider the IBM PC industry. It is asserted that the IBM PC architecture itself is not the source of revenues in this industry. Instead, it is the conformance of the products of various vendors to that architecture that produces the revenue. This can be inferred if one considers that the success of that industry is, in all probablity, independent of the computer architecture selected. Had Digital Equipment Corporation placed the VAX architecture in a similar, open-technology posture, the PC industry most probably would have succeeded equally by putting generic, compatible VAXes in desktop boxes.

As a further reflection upon the location of value in a "standard-based" product, consider the various incarnations of computers from Apple Computer, Inc. This is an example of a single-party "standard". It is asserted that the product, while certainly popular, consistently fails to thrive because Apple, through its marketing strategy which excludes clones, attempts to derive its revenues from the excellence of its standard rather than from the wide-spread conformance to its standard.

3 Commercialization

3.1 Core Technology

Given the above basic arguments, it is proposed that the PIA core technology and implementation be commercialized by supplying it as open-source freeware. It is further proposed that some form of technology governing body be set up, for example as a standards element of the Object Management Group (OMG), whose Common Object Request Broker Architecture (CORBA) is forming the basic implementation technology of the net-distributed implementation of PIA.

3.1.1 Negative Indicators

The following concerns arise when considering the above proposal.

1. The tendency of the Government of the United States is to seek compensation for technology developed at public expense when it is delivered to the private sector for profit-generating application. Whether this tendency can be overcome in a timely manner is open to question.

2. The Government tends to regard software as key, controlled technology. Making any significant, currently relevant software publically available as open-source

freeware is contrary to the Government's default perceptions of its vital interests.

3. When the Government does release technology, its preference is to release it, if not exclusively, at least first for a significant period of time to its own, national interests. Again, release of software to the internation community over the global internet is perceived, by default, as contrary to the Government's interests.

4. The Government is hesitant to release software or other technologies that may incur a liability should malfunctions occur.

5. The establishment of a standard through a public body such as OMG is a lengthy process. Additionally, such standardization processes may result in adjustments to the standard which may or may not be entirely in keeping with the original technological intent of the effort.

6. Establishment of a technology standard opens that technology up to standards-busting efforts by those interests opposed to the standard. The example of SunSoft/Java and MicroSoft, Inc., come immediatly to mind.

3.1.2 Positive Indicators

Positive factors associated with an open-source, freeware commercialization of the PIA core technologies also exist.

1. Open-source freeware typically provides a very large, virtually zero-cost debugging and validation resource. Often, corrective measures are suggested or provided with the reports of software defects.

2. Since PIA was first mentioned as a possibility for commercialization, several parties have inquired into the opportunities available. The open-source freeware selection allows all interested parties to participate in the effort. Additionally, individual parties might agree on a distribution of product sectors in a cooperative whole so as to minimize individual risk while maximizing commercialized impact.

3. The open-source freeware approach assures customers of multiple vendors for needed services and products. This removes two fears: first, of exhorbitant price increases once an irrevocable commitment is made and second, of dependence upon the continued success of a selected vendor. Elimination of these concerns improves the likelyhood of standards/product acceptance.

4. The public standards process assures customers that change will be slow and carefully considered. Further, it gives customers with vital interests an opportunity to participate in that process.

5. The open-source freeware, public standards approach allows many discipline-specific expert parties to be included in the process. This is a key element of PIA architecture commercialization since the existing work is only skeletal in its implementation of semantically-infused parameter libraries.

3.2 Perhipheral Products and Services

As mentioned previously, the proposed commercialization model supposes that revenues are derived from the provision of products and services that enable conformance to a standard and, thus, the derivation of benefit to the customer. The following revenue/benefit areas are immediately foreseen.

3.2.1 Services and Support

As in the manner of Linux (perhaps the most notable example of open-source freeware) and its supporting corporations, a certain amount of business may be done in basic service/support operations for PIA in the form of printed manuals, physical distribution media, installation services, platform support, server configuration, sales, and installation as a group, application server administration, and the like. Despite the open-source freeware foundation, it is a demonstrated fact that many customers will prefer to outsource such basic operations.

3.2.2 Expertise and Training

Perhaps representing a higher layer of the services and support spectrum, expertise (consulting) and training will probably represent a substantial portion of the revenue stream. Despite the supposed intuitive, organic nature of the PIA architecture, the technology is, as a whole, somewhat more than mildly complex. The self-revealing, object-oriented application architecture, object-oriented programming technology itself, and CORBA net-distributed object implementation technology seem to combine into a rather formidable maze, even before discipline-specific semantics are mixed into the pot. Thus, the market for the provision of expertise and training should be considerable.

The following expertise areas are immediately foreseen for both consulting and training.

1. Basic PIA technology. This includes fundamentals of the architecture such as self-revelation, semantic infusion, identification of parameters, operational encapsulation, generation of auditable project trails, organization of information within the architecture, inter-application information propagation, event notification, quality control information, and the like.

2. General wrapper design strategies. This includes all aspects of integrating a given application into the PIA standard. Areas of interest include read-only information sources (experimental data, data archives, most CAD systems, and the like), value-added applications (analysis, design, simulation codes, and the like), and consuming, distilation applications (objective function generators and the like).

3. Inter-application integration. The arrangement of applications into a directed, application graph for overall system analysis through PIA techology can be a significant, and as yet minimally explored, topic.

4. Discipline-specific parameter library support. One of the key elements of PIA technology is the infusion of semantic meaning into parameter objects. This technology has only been outlined in the present research effort; however, for practical, commercial application a great deal of effort will have to be expended in filling out the vast supply of engineering parameters and providing expertise on the precise meaning and use of those parameters.

5. Statistical characterization and optimization capabilities. The final goal of PIA integration is, of course, to produce one final, overall judgement as to the merit of a given configuration of a project. Methods for taking that judgement and producing either a design refinement or a terminal decision will probably be of the greatest complexity and will, thus, be a expertise product focus.

All of the above expertise areas will also provide business opportunities for books and other learning/training related materials. The revenue streams to be derived from such materials should not be belittled. Those in doubt of this need only visit the computer section of their local Borders or Barnes and Noble bookstores.

3.2.3 Browser/Search Engine Products

As noted in the introduction, PIA abandoned the browser/GUI as a product element some time ago. The GUI that presently exists is a research/debugging tool only and is not intended for distribution. Further, a search engine has never been part of the PIA effort, dispite the fact that an automated tool for seeking out specific information forms has always been expected.

Thus, these two areas are clear, competitive software product areas. In particular, the provision of GUI's with different, discipline-focused capabilities seems a safe area for commercial competition that adds value to the overall marketplace without any reasonable potential for harming the architectural application standard.

Note that the PIA architecture has not, as yet, embraced information visualization as a part of the parameter object structure. This has been considered (that is, it has been proposed that all parameter objects respond to a **DisplayYourself** command); however, at this time that functionality is considered to be a proper part of the GUI, not of the application wrapper.

3.2.4 Workbench Tools

Also completely untreated by the present PIA effort are workbench tools to facilitate the construction of application wrappers. Again, this represents an area for competitive software product development which is not expected to harm the integrity of the application architecture.

3.2.5 Discipline-Specific Products

As mentioned in the expertise section, the formulation of discipline-specific, semantically-infused parameter libraries is a key element of the PIA project that has, to date, only been treated in a skeletal, expositional manner. The definition and implementation of these libraries represents a mix-and-match software product area from which vendors from different discipline areas may derive revenue.

Note, though, that in this area head-to-head competition is not exactly a good thing. Discipline areas must agree on standards for the semantic and functional content of implemented parameters. Variation or overlap in encapsulated information will be the kiss of death on the solution to the *n-squared* application integration problem. Actual cooperation to assure that parameter challenges within a discipline are only solved once are essential.

3.2.6 Packaged Application Products

The PIA technology intends to enable a plug-and-play, mix-and-match application integration environment. To the extent that standardization discipline and the standardized technology achieves this goal, a significant market

for pre-wrapped, PIA-conformant applications will be enabled. This will allow customers to pick analysis packages from the marketplace as needed and drop them into his individual, technology-system puzzle.

The delivery of pre-wrapped application packages is seen as the principal operational mode for customers who wish to conduct confidential (in a business sense), in-house analysis of their product systems.

3.2.7 Served Application Products

Extending the concept of packaged application products, it is expected that a new mode of net-available application services will result from widespread use of standardized PIA technology. In this mode wrapped applications are provided not in physical, shrink-wrapped cardboard boxes, but through global-net-accessible servers. Suitable credit arrangements can be made to derive revenue from the use of proprietary application products.

Consumers of such services will be able to use either singly or in combination (supposedly) expert analysis applications from different vendors to meet the unique requirements of their own product system without the need to physically obtain, maintain, update, license, etc., etc., the needed software products. Additionally, the providers of such application services need never let their proprietary, competitive-advantage software outside of the bounds of their own firewalls. The ability to sell the services of a software application without releasing the code of that application is enabled.

3.2.8 Served Information Resources

The use of engineering databases, either through shrink-wrapped delivery or through net-accessible servers is further enabled by PIA technology. On-line databases already exist; however, these databases are limited by the fact that the semantics of their content is not expressed in a machine-interprettable form. By presenting such information through PIA technology, such information can be incorporated into system analysis just as other applications are.

For example, a facility having archives of flow-field data presented through PIA technology can have that data incorporated as the starting point for flow field analysis codes analyzing problems of similar characteristics simply by connecting the experimental data “application” into the application graph.

4 Unanswered Questions

The open-source freeware commercialization model simply assumes that the vast body of CORBA-implemented, generic PIA code will materialize fortuitously out of nowhere. Finding a funding source for such an altruistic act is unlikely. Eventually, the Government’s PIA effort may provide the expected code and documentation (provided we aren’t zeroed-out first) but whether this will be timely or not remains to be seen.

References

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